A Comparison of NAPCA and IIA Source Sampling Methods

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ABSTRACT

Results of tests involving simultaneous sampling of an incinerator using the NAPCA and Incinerator Institute of America T-6 trains indicate that results vary appreciably depending upon the test method used.

INTRODUCTION

In the past, far too little emphasis has been placed on the type of source-sampling equipment used to measure particulate emissions from incinerators. Among the most widely used incinerator sampling techniques are those developed by the Incinerator Institute of America (IIA) and the National Air Pollution Control Administration (NAPCA). Tests involving simultaneous sampling using the IIA T-6 train and the NAPCA train indicate that test results vary appreciably.

The incinerator sampled during this comparison study is a retort-type multiple-chamber unit equipped with primary and secondary burners. Maximum rated capacity is 250 pounds of Type 1* waste per hour. Effluent gases exit from the incinerator at the top of the secondary chamber and enter a spray scrubber. A variable-speed exhaust fan following the scrubber allows the operator to control exhaust gas flow rate (Figure 1).

SAMPLING PROCEDURE

Sampling was conducted at the inlet and outlet of the scrubber downstream of the fan, Figure 1. Four samples were taken simultaneously for each run: one sample with a T-6 train at point A (inlet), one sample with the NAPCA train at point A, one sample with the T-6 train at point B (outlet), and one sample with the NAPCA train at point B. Sampling was conducted at predetermined points of average velocity in the duct.

With the following exceptions, sampling with the T-6 train was conducted exactly as specified in the IIA's "Bulletin T-6: Incinerator Testing"[1] and sampling with the NAPCA train was conducted as required by NAPCA's "Specifications for Incinerator Testing at Federal Facilities."[2]

1) Sampling time was not always 3 hours.

2) Standard waste was prepared as described in the NAPCA "Specifications." However, the moisture content of the waste exceeded that allowed for a standard test.

3) Results of the T-6 samples are reported in grains per standard cubic foot rather than in pounds per hour.

*80 percent rubbish, 20 percent garbage.

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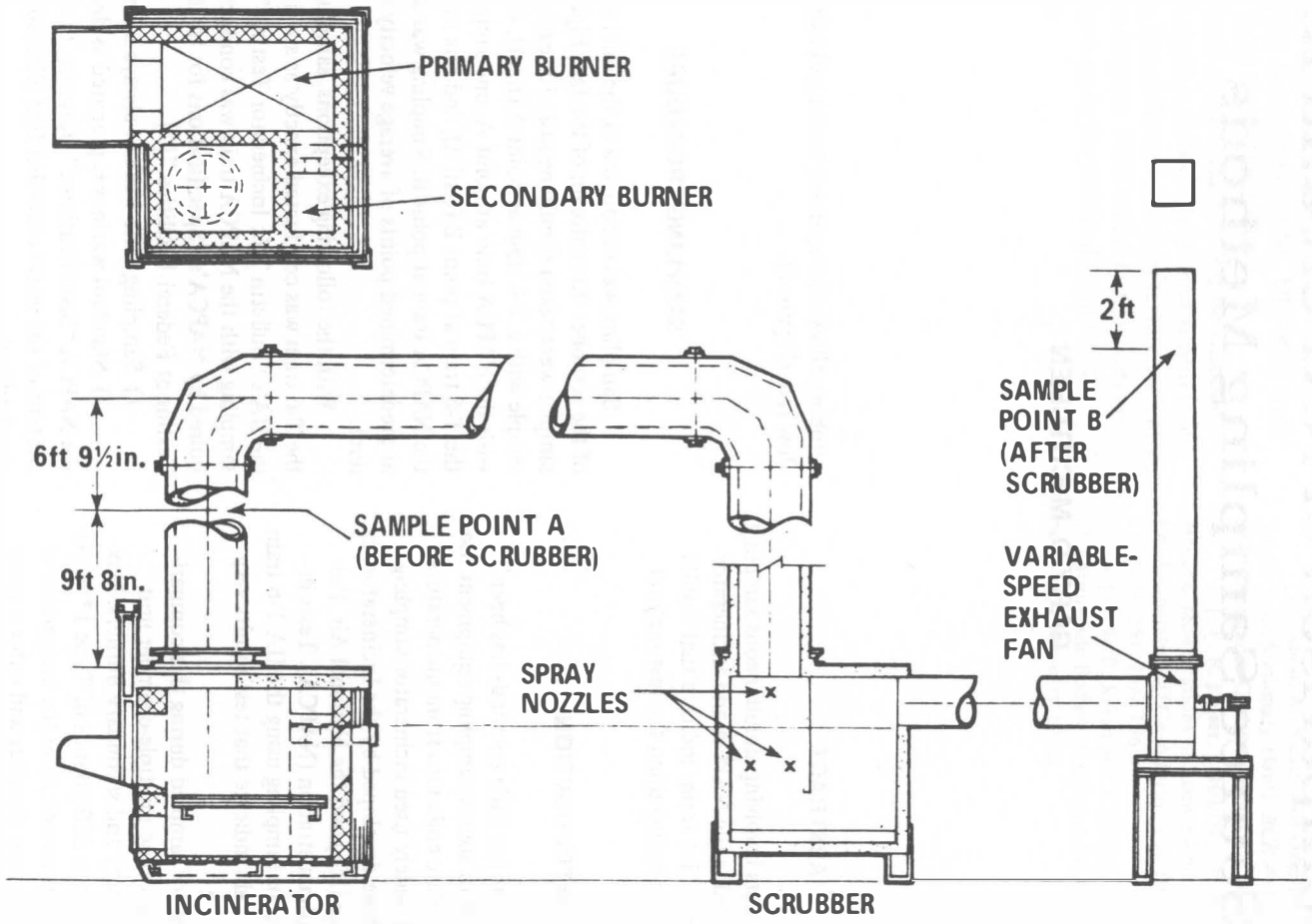

FIG. 1 SCHEMATIC VIEW OF TEST INCINERATOR.

Incinerator charging rate, scrubber water level, and exhaust fan speed were varied for different runs to simulate various operating conditions.

All samples were collected and analyzed by the Source Testing Section, Engineering Branch, NAPCA.

Laboratory procedures for the T-6 samples were carried out as specified in Bulletin T-6. Laboratory procedures for the NAPCA samples were conducted according to the procedure required by the "Specifications" except for one additional step. The residue from the impinger water remaining after the organic extraction was evaporated to dryness was weighed to the nearest tenth of a milligram and added to the total particulate. This additional step has been incorporated into a revision to the "Specifications," which should be published in the near future.

DISCUSSION

Incinerator data and test results are summarized in Tables 1 and 2. Test 7 was conducted with both the primary and secondary burners turned off and with a low scrubber water level, to simulate a poorly designed incinerator. In addition, secondary burners were not used during Tests 1, 2, and 3; and the primary burners were not used during Tests 10, 11, 12, 15, 16, 17, and 18.

Tests 14B and 17B were considered to deviate too far from isokinetic conditions to be acceptable. The other tests were made within ± 15 percent of isokinetic conditions.

The term "negative" under the weight of particulate for the T-6 bag in Table 2 means that the tare bag weight was more than the weight of the bag after the test. In these cases, the bag weights were ignored and only the cyclone weights were used, i.e., the negative difference was assumed to be zero.

Both NAPCA and T-6 results were calculated on the basis of grains per standard (70°F, 1 atm) dry cubic foot of flue gas (SCF). For the T-6 train, this concentration was determined by assuming that the T-6 sample was 100% isokinetic and then multiplying the ratio of nozzle area to stack area by the dry stack gas flow rate to obtain the volume of gas sampled by the train. The weight of particulate collected was then divided by this volume of gas and the result converted to grains per SCF. This method of calculation is necessary because the quantity of gas sampled by the T-6 train is not measured. Since NAPCA equipment measures the dry gas volume sampled, the result in grains per SCF can be easily determined by converting milligrams to grains and dividing by the dry gas volume sampled.

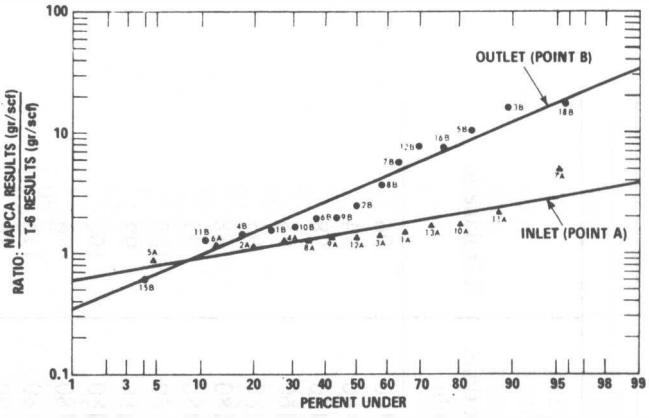

FIG. 2 PROBABILITY PLOT OF INLET AND OUTLET RATIOS.

The ratio of NAPCA to IIA results before and after the scrubber was plotted on log-probability paper (Figure 2). The difference between the inlet and outlet lines indicates that inlet and outlet ratios vary; and since the main difference between inlet and outlet results was the particulate loading of the flue gas, there is a possibility of a correlation between the ratios and particulate loading.

Figure 3 compares the ratios with the grain loading obtained by the T-6 train. A least-squares fit was made, and the equation obtained is:

$$y = 0.366\ X^{-0.549}$$

The correlation coefficient for the equation is -0.80. The shaded area encloses the 90 percent confidence interval.

CONCLUSIONS

This study confirmed that incinerator emission test results vary according to the type of sampling equipment used to make the test. Figure 2 also makes

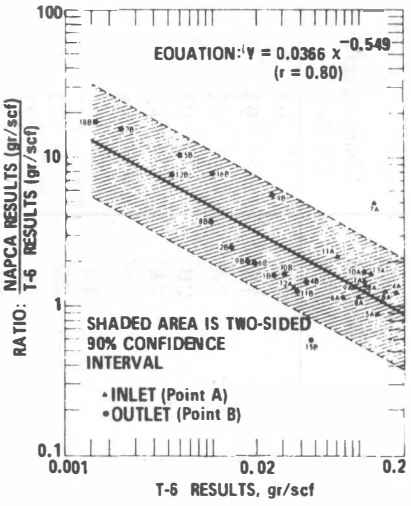

FIG. 3 COMPARISON OF NAPCA AND IIA TEST RESULTS.

TABLE 1 OPERATING CONDITIONS-COMPARATIVE IIA-NAPCA INCINERATOR TESTS

Test No.	Incinerator data				Test time, min.	% Isokinetic
	Charging rate, lb/hr	Burner gar usage, cfm		Secondary chamber temp., °F		
		Primary	Secondary			
1A	93	375	Off	1090	180	96
1B	93	375	Off	1090	180	94
2A	92	360	Off	1273	180	98
2B	92	360	Off	1273	160	98
3A	88	360	Off	1243	180	95
3B	88	360	Off	1243	180	88
4A	172	Off	600	1442	180	99
4B	172	Off	600	1442	180	105
5A	127	360	600	1712	180	99
5B	127	360	600	1712	180	106
6A	103	360	600	1398	180	98
6B	103	360	600	1398	180	115
7A	180	Off	Off	1054	90	86
7B	180	Off	Off	1054	90	92
8A	180	On	600	1320	90	104
8B	180	On	600	1320	90	100
9A	175	On	600	1601	90	100
9B	175	On	600	1601	90	111
10A	176	Off	240	1427	90	94
10B	176	Off	240	1427	90	96
11A	183	Off	600	1094	90	98
11B	183	Off	600	1094	90	89
12A	240	Off	300	1260	180	100
12B	240	Off	300	1260	180	100
13A	125	On	> 600	1533	180	89
14B	146	192	600	1373	NAPCA:169 T-6:180	82
15B	197	Off	600	1033	NAPCA: 60 T-6:180	93
16B	237	Off	370	1234	NAPCA: 60 T-6:180	87
17B	152	Off	627	1431	180	69
18B	105	Off	540	1638	180	89

TABLE 2 TEST RESULTS-COMPARATIVE IIA-NAPCA INCINERATOR TESTS

Test No.	T-6 test results			NAPCA Test results			Ratio: NAPCA/T-6
	Particulate, mg.		Particulate, gr/scf dry	Total particulates, mg	Part. caught after filter %	Particulate, gr/scf dry	
	Bag	Total					
1A	198.3	980.7	0.1077	627.9	8.5	0.1573	1.46
1B	254.1	328.1	0.0267	222.8	37.0	0.0425	1.59
2A	268.2	766.7	0.0992	396.3	16.7	0.1145	1.15
2B	116.9	145.1	0.0136	159.2	47.9	0.0335	2.46
3A	175.4	912.4	0.1087	546.5	14.7	0.1515	1.39
3B	6.2	29.4	0.0024	179.0	40.5	0.0370	15.42
4A	432.9	2886.4	0.1773	1575.3	4.4	0.2147	1.21
4B	313.0	1008.0	0.0431	373.4	24.5	0.0619	1.44
5A	108.1	1454.8	0.1331	583.2	7.5	0.1188	0.89
5B	Negative	87.5	0.0061	233.2	28.8	0.0631	10.34
6A	Negative	951.8	0.0756	491.0	7.9	0.0872	1.15
6B	154.5	283.2	0.0193	156.2	38.6	0.0375	1.94
7A	243.0	707.9	0.1266	1361.3	21.1	0.6208	4.90
7B	166.1	430.3	0.0256	561.0	43.6	0.1440	5.62
8A	180.1	1009.5	0.1489	589.1	7.1	0.1844	1.24
8B	Negative	105.2	0.0100	97.8	48.4	0.0371	3.71
9A	40.1	627.4	0.0904	378.4	8.8	0.1197	1.32
9B	59.8	162.0	0.0173	87.4	56.9	0.0343	1.98
10A	315.4	692.2	0.1086	501.4	14.1	0.1844	1.70
10B	238.6	321.1	0.0310	124.1	62.4	0.0509	1.64
11A	167.7	819.7	0.0713	431.8	19.0	0.1556	2.18
11B	71.3	692.2	0.0379	195.7	41.9	0.0489	1.29
12A	371.2	560.7	0.0359	336.0	35.9	0.0473	1.32
12B	86.3	123.2	0.0054	226.0	50.6	0.0408	7.56
13A	808.7	895.2	0.1170	603.4	1.9	0.1957	1.67
14B	74.9	156.6	0.0073	183.7	5.0	0.0246	–
15B	456.7	661.0	0.0466	55.7	61.5	0.0280	0.60
16B	Negative	149.7	0.0101	150.3	77.9	0.0768	7.60
17B	21.7	89.1	0.0026	323.4	54.0	0.0547	–
18B	Negative	62.5	0.0016	230.4	25.6	0.0277	17.31

it clear that no simple correlation between the two methods (NAPCA and T-6) exists. At best, a "sliding ratio" based on particulate concentration can be obtained by plotting data as in Figure 3. The lines in Figure 3 should not be extrapolated beyond the data because of the obvious lumping of data at higher dust concentrations.

REFERENCES

[1] Bulletin T-6, Incinerator Testing. Incinerator Institute of America, 60 East 42nd Street, New York, N. Y. 10017. August 1968. 17 pages.

[2] Specifications for Incinerator Testing at Federal Facilities. U.S. DHEW, PHS, NAPCA, 411 West Chapel Hill Street, Durham, North Carolina. October 1967. 33 pages.